Federal Highway Administration
of the U.S. Department of Transportation

Commuter Choice and Congestion-Based Pricing on Atlanta's Interstate System

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Introduction

The current Atlanta Value Pricing Project was approved for funding and implementation by the FHWA under the Value Pricing Pilot Program. This memorandum constitutes a request for a no-cost change in scope to this ongoing project and a request for the final federal funding increment to be made available for this project from this year's budget.

In Phase I ($1.4 million) the Atlanta value pricing team instrumented 500 vehicles in 270 representative households to monitor baseline household and vehicle travel activity. The one-year baseline data collection effort began in August 2003 and will be completed shortly. To date, this project has yielded the largest household travel and driver behavior data set ever assembled. More than 600,000 vehicle trips have been monitored on a second-by-second basis. The baseline vehicle activity data are coupled with data collected during household interviews, two-day travel diaries, and employer commute options surveys. The Phase I effort now provides the baseline data needed in a statistical assessment of changes in travel behavior that will result when mileage-based pricing is introduced. In the continuation of the Atlanta congestion pricing project, the team will implement mileage-based and congestion-based charges for the current participants and evaluate household response to pricing.

The Atlanta team is proposing to modify the scope of the $2.77 million project originally approved for funding by the Federal Highway Administration. The Atlanta project was designed to collect baseline data, implement mileage-based insurance charges for a test population, and evaluate the effects of pricing on household travel behavior. Whereas the original project focused on evaluating the effects of mileage-based insurance fees, the modified project will implement a more generalized pricing approach to implementing mileage-based charges across the participating households for one year. Then, in the fifth and sixth quarters, after hardware and software modifications are made to the deployed equipment, the team will implement real-time congestion pricing of freeway activity for a subset of the participating households. In this second wave of pricing, the cent/mile charge will be more than doubled during peak-period and incident-related congestion. A trip planning website will be provided and an in-vehicle feedback system (LCD panel that can receive pricing messages) will allow households to see the price of each trip that is made. This change in scope allows the team to assess the potential impacts of congestion pricing on not only the total daily trips and mode choice, but also on the decisions to shift travel out of the most congested periods.

The pricing implementation and analytical results will provide a significant practical benefit to the Atlanta region. The region is currently in the design process for a new major construction effort along the I-75 corridor. New capacity will be added to I-75 and a combined high occupancy tollway and bus rapid transit system will be implemented along the corridor (forecast for the year 2011). The State Road and tollway Authority and Atlanta Regional Commission are also considering the implementation of variable congestion pricing along this corridor as well and are supporting research efforts in this area. The results from the ongoing Atlanta value pricing project would provide the information necessary to evaluate the potential effects that such a system would have on sub-regional travel demand, mode choice, and shifting travel outside of the peak period. Because the value pricing initiative examines the marginal effects of pricing across a variety of demographic characteristics, such analyses will yield more refined

relationships (avoiding the use of average demand elasticities) into regional travel demand and simulation models. A separate linkage to an ongoing National Science Foundation project at Georgia Tech will allow the NSF researchers to evaluate the potential effects of a HOT lane reservation system. The researchers are currently simulating a system in which users reserve their space on the HOT system in advance at a lower rate, with optimization routines adjusting the onroad price to fill any excess capacity.

The total budget and federal allocation to the project will remain unchanged as a result of the change in scope. The original total federal support for this project was $2,216,328, of which $1,205,465 was provided for baseline travel behavior data collection. The remaining balance of $1,180,863 is requested this year. Budget categories will need to be reallocated somewhat to accommodate the changes. The proposed modification to subtotals in various budget categories is provided in a spreadsheet later in this memorandum.

The State of Georgia fully supports the demonstration program, as demonstrated by the support from the Governor's office and the high levels of cooperation that have been forged between state and local transportation agencies. The State has already provided the required matching funds for the entire $2.8 million project during our Phase I efforts and awaits FHWA's decision to continue this value pricing project.

Progress to Date:

The first phase of this project collected the baseline data necessary for the implementation of mileage-based pricing. The data collection began in August 2003 and will be completed shortly. In May 2004, the Georgia Department of Transportation provided the remainder of the matching funds ($107,000.00) dedicated to the entire project. These funds, delivered in advance of ongoing FHWA funding, provided the necessary resources to continue the baseline field data collection through December 2004 and to perform analytical activities originally slated for the second phase of the project. The following analytical activities are currently underway:

1. Continue data collection through December 2004.
2. Perform trip-level data analysis
    a. By September 2004, process and analyze all trip-level data collected between August 2003 and July 2004
        i. Descriptive statistics of tripmaking activity
        ii. Temporal differences in tripmaking activity
        iii. Cross-tab analysis of tripmaking activity by demographic characteristics
    b. By January 2005, process and analyze all trip level data collected from August 2003 through November 2004
        i. Descriptive statistics of tripmaking activity
        ii. Temporal differences in tripmaking activity
        iii. Cross-tab analysis of tripmaking activity by demographic characteristics
3. Perform route-level analysis (limited by processing time and analytical resources)
    a. By December 2004, process to route (roadway facility) and analyze all GIS data collected between August 2003 and April 2004
        i. Analyze vehicle speeds by facility type, vehicle type, and demographics
4. Compare travel diary and instrumented vehicle data in Summer 2004
    a. Compare 2-day travel diary data with instrumented vehicle data

b. Descriptive statistics
c. Quantify trip under-reporting
d. Perform cross-tab analyses on under-reporting across demographics

Figures illustrating analytical results for the first 6 months of data analysis are appended to this memorandum. The first charts illustrate the locations and demographic characteristics of the households currently included in the study. The next series of charts provides summaries of vehicle activity by day of week and month. The detailed data allow the team to assess tripmaking by a wide variety of demographic and socioeconomic characteristics. For example, one chart illustrates the noted differences in trips per day across gender and age groups. Time of day activity summaries, useful in regional emissions analyses can also be generated from the data. The next figure illustrated differences in the range of vehicle operations as a function of household characteristics (e.g. commuters, vs. soccer parents, vs. retirees). The last two charts illustrate the benefits of the GPS data stream and allocation of trips to actual onroad roadway links. Comparisons of travel speed vs. speed limits and other roadway characteristics are supported by the deployment. Finally, from an operations standpoint, the data have been very useful for identifying locations of recurrent congestion by time of day.

Proposed Modifications to Implementation Plan

As outlined earlier, the team proposes to implement mileage-based and congestion-based charges for the current participants and evaluate household response to pricing. The original proposal centered around the conversion of insurance premiums into cent-per-mile rates and evaluating the effects of such pricing strategies. The modified scope calls for a much more general approach to mileage-based pricing and introduces variable congestion pricing with driver feedback. The FAIR lanes evaluation on route diversion in the original proposal is also effectively replaced by the variable congestion pricing experiment. This also constitutes a technical improvement, because the relatively small number of households that commute the Georgia 400 corridor are replaced with a wider population segment commuting along all of the metro Interstates. The following outlines the modified pricing approach that would be employed:

1. Beginning in January 2005, the research team would begin the mileage-based pricing Phase of the Atlanta value pricing project. Each household will start with a pool of potential refund money, based upon the number of household miles traveled during same quarter in the baseline period and an established cent/mile rate. Travel will be monitored and reported back to the households on a weekly basis. For each mile of travel, the balance in the rebate pool declines based upon the cent/mile rate. At the end of the quarter, the household will receive a check for the remaining balance in the account, reflecting their VMT reduction (from carpooling, transit use, eliminating trips, etc.) associated with their change in travel behavior. The balance will terminate at zero to maintain the hold harmless approach. In October 2004, the low-income sample will be supplemented with an additional 15 households.

2. Each quarter, the cent/mile rate will increase (also increasing the potential pool for the next quarterly rebate). Choice modeling will be used to assess the price points at which households change their travel behavior and link the change to demographic,

socioeconomic, and household travel factors. Pricing will continue until the total incentive pool for this component is exhausted ($37,000.00 over 12 months).

The team believes that the analysis of pricing implementation would significantly benefit from random assignment of price points to study participants. In this way, greater variability in pricing treatment can be included in statistical analyses and household response to price increases and decreases can be assessed. We expect that households will learn and adapt to pricing treatments (i.e. seek out alternative transportation modes). Similarly, randomized price points would allow analysts to examine potential drop-off…e.g., a household might continue to take the bus in Q3 when the price goes up, but they might have dropped out of this mode had the price remained the same. While randomized pricing is ideal, we remain concerned about sample size. There are only 30-35 households in each sampling strata, and a larger sample is needed to completely randomize the pricing.

The team proposes to implement a bounded, randomized, discrete pricing process in this deployment, changing prices for these households on a quarterly basis. An initial price of 5 cents/mile will be implemented across all households, which approximately equals the combined average per mile cost of all federal and state excise and sales taxes plus vehicle registration fees. A second quarter $0.010 mileage rate will be implemented in every household. However, in the third quarter, each household will be randomly assigned a change in mileage fee of either +$0.025, +$0.000, or -$0.025. In the fourth quarter, each household will be randomly assigned a change in mileage fee of either +$0.000, +$0.025, or +$0.050. It is interesting to note that the fourth quarter average price approximately equals the addition of household insurance paid on a cent-per-mile basis. Prices will stabilize for each household in quarters five and six to provide a consistent baseline from which the freeway congestion pricing effect (discussed later) can be isolated. This also allows the team to examine alternative mode drop-out in the control group during this second pricing wave. The average incentive schedule is outlined in the table below:

Quarterly Price	Average $/Mile Rate
Q1	0.050
Q2	0.010
Q3	0.010
Q4	0.125
Q5	0.125
Q6	0.125

3. At the end of the fourth quarter, the equipment in 150 of the vehicles will be upgraded to provide for real-time interactive communication of prices to the drivers. An LCD data terminal will be added to the vehicle and GPRS/GSM cellular service will be integrated to allow the implementation of real-time variable freeway toll pricing as a function of congestion levels. The upgrade will take approximately 3 months. The project will keep 150 of the vehicles from same demographic household groups unchanged and continue in the mileage-based programs and will retire 200 vehicles from the fleet (to compensate for upgrade costs). To ensure a valid sample, we are going to focus our efforts on only three

of the sampling strata for the variable toll pricing component. If additional moneys became available next year, we could upgrade these units and keep them in the field. If additional resources become available in 2005, these vehicles could remain in the fleet and undergo additional pricing experiments.

4. A hardware and software upgrade will allow the implementation of a point-in-polygon system on the GT Trip Data Collectors. The GPS position of the vehicle will be used to identify the roadway location (freeway link) through a lookup in an onboard database. An onboard data table will allow the unit to display to the driver the vehicle location (e.g. "I-75 between Moore's Mill and Northside Drive') and current pricing (e.g. "Congested Conditions: 27.5 cents/mile" and "Accumulated trip price $2.20"). Congested freeway conditions will be monitored through a computer linkage to the Georgia DOT's Transportation Management Center. Five-minute speed and occupancy reports will be translated into congestion level determinations. The cellular transceiver system will allow these tables to be updated every few minutes as traffic conditions change. Vehicle reporting will allow the central database to calculate the price for each trip and deduct the cost of each trip from the incentive bank.

5. The fifth and sixth quarters of pricing will include the incorporation of a 20 cents/mile freeway congestion fee on top of the 12.5 cents/mile mileage-based fee. That is, when the vehicle is operated under uncongested conditions, the driver will pay 12.5 cents/mile (average), and when the vehicle is operated under congested conditions, the driver will pay 32.5 cents/mile (average). For a commute trip of 10 or more freeway miles, the pricing level matches well with proposed tolls on Minnesota Highway 394 (projected to cost $1 to $4 during the weekday rush hours).

   The incentive pool is raised accordingly, to reflect the amount of baseline travel for each household under congested conditions. Participants can now shift trips previously occurring under congested conditions to other time periods and retain additional savings in their quarterly rebate. Choice modeling will now be used to assess the relative change in both the amount of travel, as well as the shift in travel away from congested conditions to uncongested periods.

   This pricing system will remain in effect for six full months to allow participants to become accustomed to the pricing and to gauge their adaptation to the pricing system (i.e. route diversion to arterial routes and shifts of trips out of the peak periods). Pricing will continue until the total incentive pool for this component is exhausted ($37,000 over 6 months). Because the incentive pool will become more easily exhausted, households will need more than quarterly opportunities to adapt to the pricing. In the variable pricing segment of the implementation, incentives will be distributed monthly. This will allow households to better adapt to the pricing implementation.

   Because traffic speed and density can be monitored directly from the Advanced Transportation Management Center, pricing for each roadway segment will be based upon actual onroad conditions. The team will also investigate the use of a two-tier congestion fee ($0.15/mile for typical peak-period 30-45 mph congested conditions, and

$.25/mile for the most severely congested conditions). However, implementation of this pricing scheme will depend upon the rate at which data can be streamed from the ATMS center and analyzed by the team, and the accuracy of speed predictions that come from these analyses to ensure that speed and density differentiation are accurate.

6. The demonstration project will provide data to assess the potential effects that mileage-based and congestion-based pricing will have on total travel and on travel by time of day. Because we have information on the demographic and travel characteristics of the households (income, vehicle ownership, household member ages, employment status and classifications, child care and school constraints, etc.) and their revealed demand response to pricing, we can provide much greater resolution in defining the household characteristics that will be important in defining travel pattern changes. The analytical results will allow us to better assess the potential impacts of congestion pricing along the I-75 corridor. That means that when we simulate the implementation of HOT/BRT lanes on the I-75, we can use more refined demand elasticities for predicting changes in travel by household group, rather than using an overall demand elasticity from another toll road.

7. A follow-up survey to identify factors that may have affected travel changes and to collect limited stated preference data associated with tripmaking will also be conducted for each household when the instrumentation is uninstalled.

Proposed Modification to Project Budget

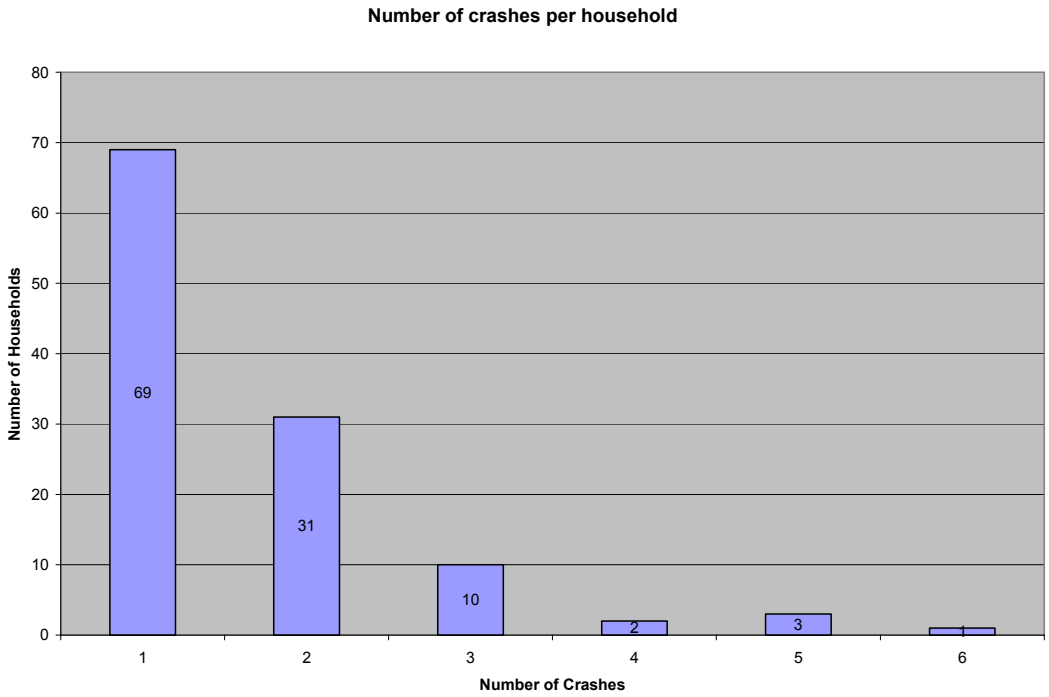
The overall budget for this project remains unchanged, at $2,770,409.58 (federal contribution of $2,216,327.66). The FHWA previously provided $1,035,465.00 in Phase I funding. The federal balance for this project remains unchanged at $1,180,862.66. We are requesting this allocation from this year's federal program budget. To accommodate the change in scope proposal, the team proposes to shift moneys between budget categories (see below). The matching funds requirement for the entire project has already been more than met in hard dollar contributions of state funds from the Georgia Department of Transportation and Georgia Institute of technology (see below). To date, the State has provided 27% in matching funds. An additional $100,000 soft match (not included in the calculation) was provided by the Georgia Regional Transportation Authority in the form of a 2002 Value Pricing Conference.

	Approved Request	Federal (80%)	Federal Received	Federal Balance	Proposed Balance	Difference
Personal Services	$805,096.54	$644,077.23	$241,933.00	$402,144.23	$396,431.58	$(5,712.65)
Fringe Benefits	$95,908.47	$76,726.78	$29,319.00	$47,407.78	$59,778.00	$12,370.22
Materials & Supplies	$25,500.00	$20,400.00	$7,949.00	$12,451.00	$26,000.00	$13,549.00
Incentives	$156,967.21	$125,573.77	$0	$125,573.77	$74,190.00	$(51,383.77)
Travel	$12,600.00	$10,080.00	$2,400.00	$7,680.00	$9,500.00	$1,820.00
Capital Equipment	$76,000.00	$60,800.00	$0	$60,800.00	$6,500.00	$(54,300.00)
Sub-Contracts	$1,274,282.79	$1,019,426.23	$634,805.00	$384,621.23	$415,200.00	$30,578.77
Indirect	$324,054.57	$259,243.65	$119,059.00	$140,184.65	$193,263.08	$53,078.43
TOTAL	$2,770,409.58	$2,216,327.66	$1,035,465.00	$1,180,862.66	$1,180,862.66	$0.00

State Matching Funds	**Paid through 2004**	
Source	**Amount**	
Original GDOT Funds	$258,867.00	
GT Equipment Match	$40,000.00	
GDOT Funds 4/29/2004	$107,416.00	
GT Overhead Waivers	$187,724.63	
Total	$594,007.63	27%

Crash Data and Insurance Pricing Analysis

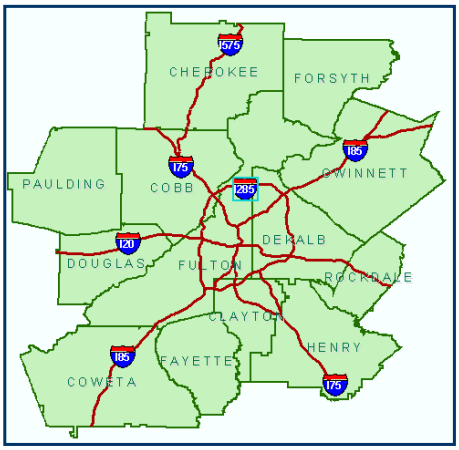
A significant side-benefit of the current value pricing project in Atlanta is the use of instrumented vehicle data in safety analysis. The team continues to collect and analyze crash data as part of the deployment effort. After establishing a cooperative agreement with the Department of Motor Vehicle Safety, the team assembled the 2000-2004 crash histories for all study participants. The crash rate is approximately 11.2% per year. The figures below summarize the crash database figures for the Commute Atlanta participants.



In her dissertation, Jennifer Ogle is currently modeling the linkage between crash occurrence, crash type, and at-fault findings with both accumulated VMT and observed instrumented vehicle driver behavior (speed/acceleration, etc.). This dissertation will be complete in August 2004. The analyses are very exciting and the modifications to our research scope will continue to support these types of analysis.

The modified implementation plan will also continue to support the evaluation of value pricing insurance initiatives. During the pricing implementation, the mileage-based fees cross the $0.10 /mile threshold during the third quarter, which reflects the approximate average cost of insurance. Hence, the economic analyses can be used directly to evaluate the potential effects of insurance pricing implementation. Households will be providing their actual insurance rates so that the analyses can be linked back to individual driver behavior and household response.

Commute Atlanta Study Area



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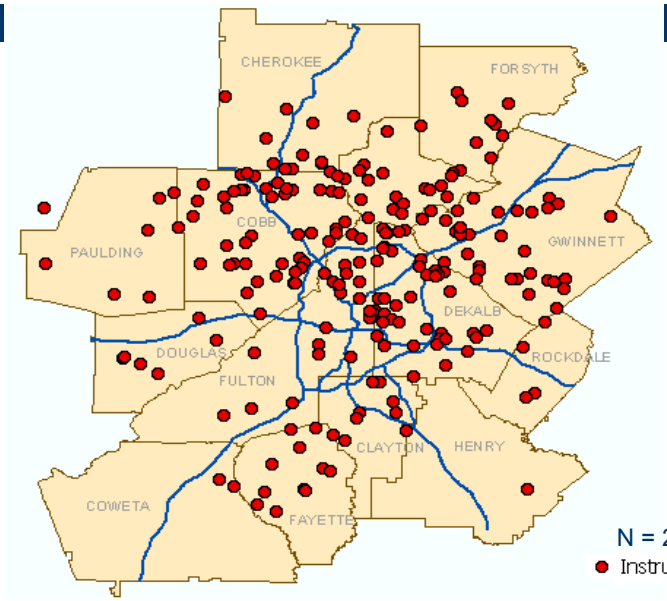
Commute Atlanta Instrumented Vehicle Households



January 2004

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Commute Atlanta Sample February 29, 2004

Sampling Group	Annual Income	HH Size	# Vehicles	Population %	Sampling Status	HH Sample Target	HH Recruited
0	Any	Any	0	7.4%	Omit	0	0
1	<30k	Any	1+	18.4%	Include	35-40	22
2	30-75k	1	1+	11.3%	Include	35-40	32
3	30-75k	2+	1	6.8%	Include	35-40	18
4	30-75k	2	2+	10.6%	Include	35-40	35
5	30-75k	3+	2+	13.9%	Include	35-40	35
6	75k+	1	1+	2.8%	Omit	0	5
7	75k-100k	2+	1+	12.1%	Include	35-40	36
8	>100k	2+	1+	16.8%	Include	35-40	67
99	Unknown	Any	Any	n/a	Omit	0	23
				100.0%		280	273

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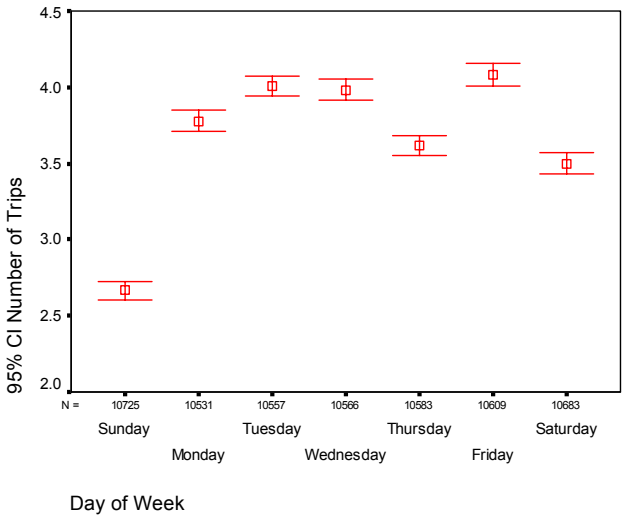
Trips by Day of Week



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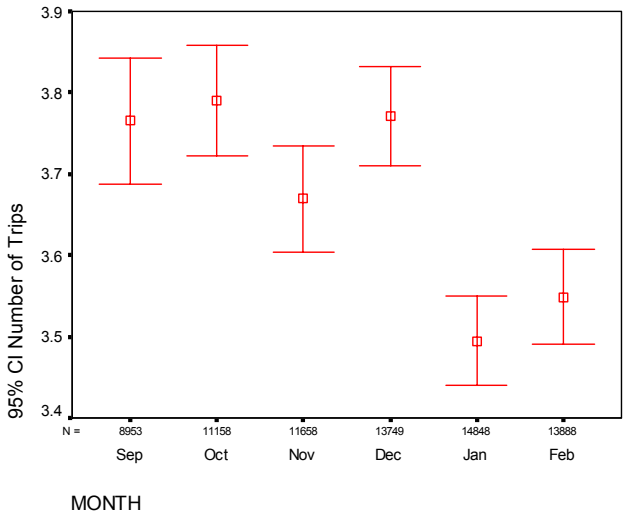
Trips by Month



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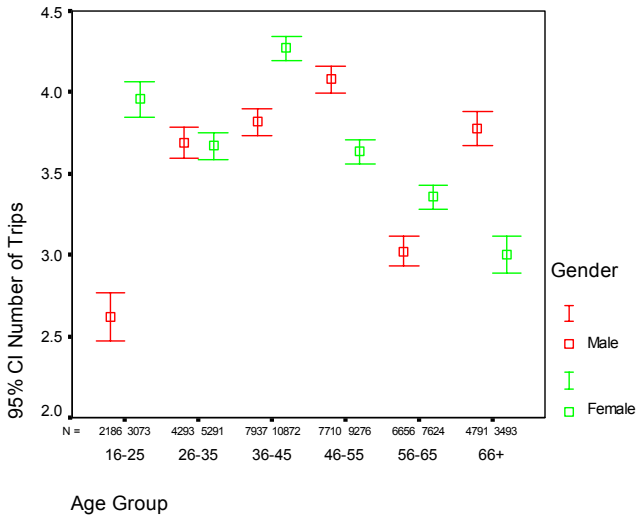
Average Number of Trips per Day by Gender and Age Group



Strata Weighting)

Roughly 5.2 trips/day/vehicle, when trips are made …

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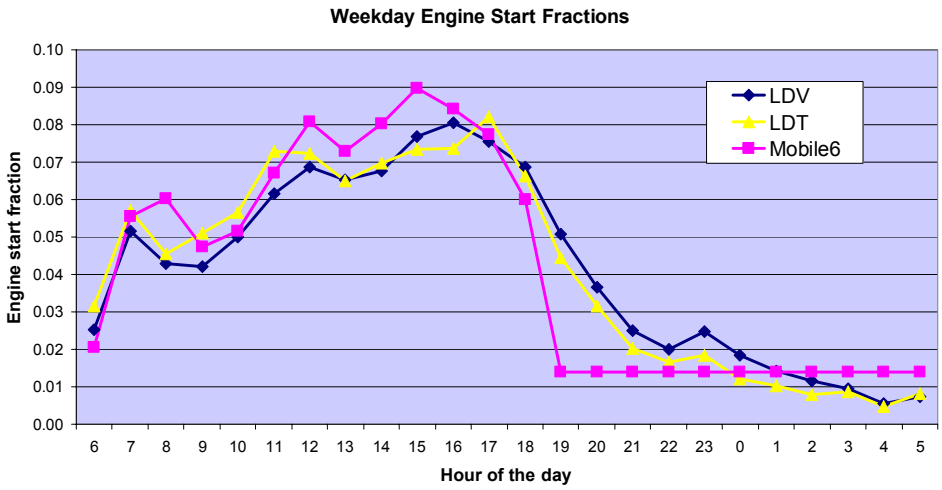
Weekday Engine Start Fractions by Hour of Day



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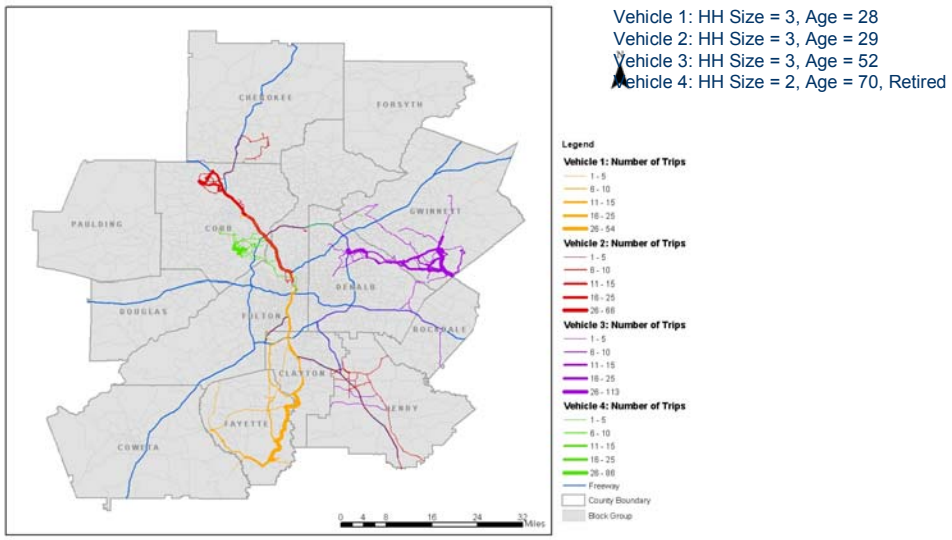
Range of Operations Four Vehicles: Two Months of Travel



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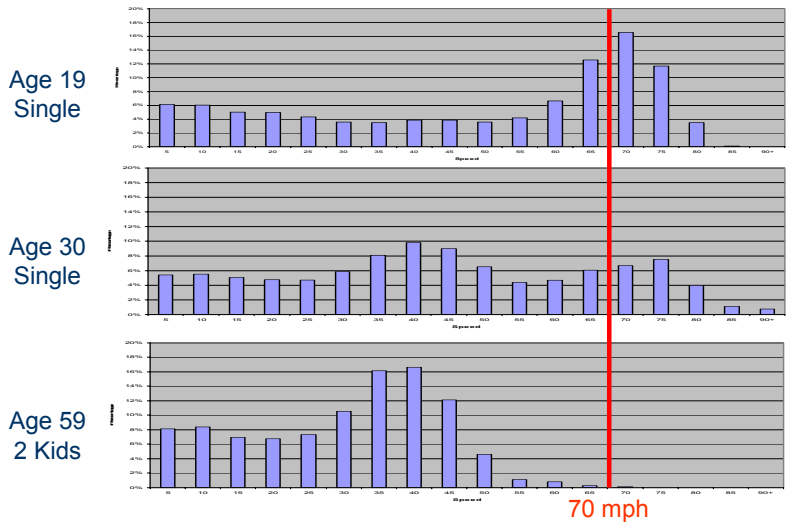
Speed Histograms
Three Female Participants



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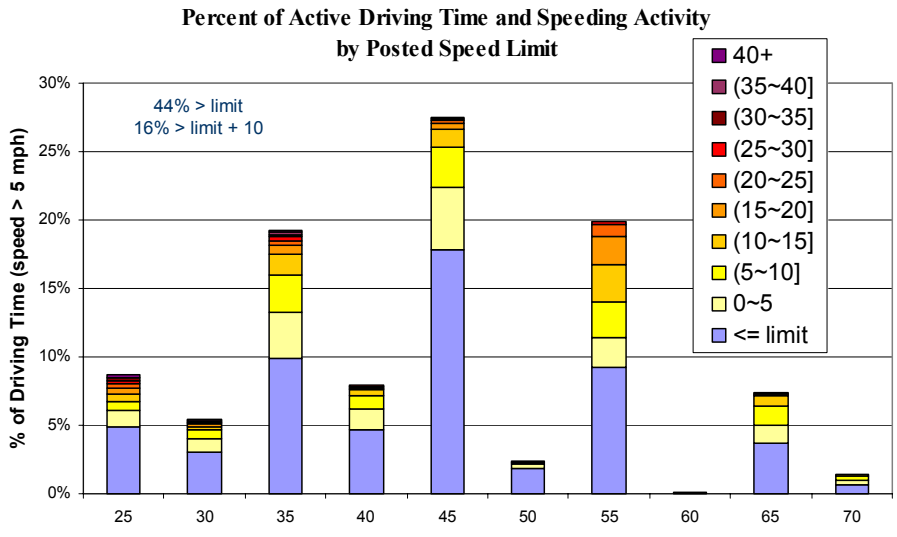
Speeding by Speed Limit (v > 5mph)
(10% of 11/03-1/04 Trips Processed to Route)



10% of fleet (11/15/03-1/15/04)
1472 Vehicle-Hours

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